# Contents

Preface vii
Welcome address viii
Committees and scientific societies x
Foundations and companies xi
Movie sessions xii
Contents xiii

**1. General lectures**

*H. Hasimoto*
Elementary aspects of vortex motion 1
*P.G. Saffman*
The stability of vortex arrays to two- and three-dimensional disturbances 13
*H.K. Moffatt*
Generalised vortex rings with and without swirl 22
*J.J. Keller, W. Egli and R. Althaus*
Vortex breakdown as a fundamental element of vortex dynamics 31
*E.-A. Müller and F. Obermeier*
Vortex sound 43
*T. Maxworthy*
Waves on vortex cores 52
*H. Aref, J.B. Kadtke, I. Zawadzki, L.J. Campbell and B. Eckhardt*
Point vortex dynamics: recent results and open problems 63

**2. Two dimensional vortices**

*R.E. Caflisch*
Nonlinear analysis for the evolution of vortex sheets 75
*D.G. Dritschel*
The repeated filamentation of vorticity interfaces 78
*Y. Giga and T. Kambe*
Large time behavior of the vorticity of 2D viscous flow and vortex formation in 3D flow 83
*P. Capéran and J. Verron*
Numerical simulation of a physical experiment on two-dimensional vortex merging 87
*R. Krasny*
Numerical simulation of vortex sheet evolution 93
*Y. Kimura*
Chaos and collapse of a system of point vortices 98
*H. Yamada, H. Yamabe, A. Itoh and H. Hayashi*
Numerical analysis of a flowfield produced by a pair of rectilinear vortices approaching a circular cylinder 105

*J.M.R. Graham and P.D. Cozens*
Vortex shedding from edges including viscous effects 111
*M. Okude and T. Matsui*
Process of formation of a vortex street in the wake behind a flat plate 115
*W.K. Soh, K. Hourigan and M.C. Thompson*
The shedding of vorticity from a smooth surface 122

**3. Ring and three dimensional vortices**

*C.W. van Atta, M. Gharib and M. Hammache*
Three-dimensional structure of ordered and chaotic vortex streets behind circular cylinders at low Reynolds numbers 127
*Y. Oshima, N. Izutsu, K. Oshima and A.K.M.F. Hussain*
Bifurcation of an elliptic vortex ring 133
*E. Meiburg, J.C. Lasheras and Wm.T. Ashurst*
Topology of the vorticity field in three-dimensional shear layers and wakes 140
*F.R. Hama*
Genesis of the LIA 149
*A. Sym*
Vortex filament motion in terms of Jacobi theta functions 151
*Y. Fukumoto and T. Miyazaki*
Three-dimensional distortions of a vortex filament: exact solutions of the localized induction equation 157
*S. Kuwabara*
Pseudo-canonical formulation of 3-dimensional vortex motion and vorton model analysis 163
*J.J.W. van der Vegt*
Fundamentals of three-dimensional vortex motion around solid bodies 179
*U. Dallmann*
Three-dimensional vortex structures and vorticity topology 183
*A. Braathen and O.M. Faltinsen*
Interaction between shed vorticity, free surface waves and forced roll motion of a two-dimensional floating body 190
*M. Kiya and H. Ishii*
Vortex dynamics simulation of interacting vortex rings and filaments 197
*J.Z. Wu, J.M. Wu and C.J. Wu*
A viscous compressible flow theory on the interaction between moving bodies and flow field in the $(\omega, \vartheta)$ framework 203
*D. Auerbach*
Some open questions on the flow of circular vortex rings 209
*P.W. Bearman and M. Takamoto*
Vortex shedding behind rings and discs 214
*S. Shingubara, K. Hagiwara, R. Fukushima and T. Kawakubo*
Transition process from one celled vortex to two celled vortex 219
*V.J. Modi, F. Mokhtarian, T. Yokomizo, G. Ohta and T. Oinuma*
Bound vortex boundary layer control with application to V/STOL airplanes 225
*Q.-d. Wei, R.-s. Lin and Z.-j. Liu*
Vortex-induced dynamic loads on a non-spinning volleyball 231

**4. Reconnection of vortices**

*M.I. Aksman and E.A. Novikov*
Reconections of vortex filaments 239
*M.V. Melander and N.J. Zabusky*
Interaction and "apparent" reconnection of 3D vortex tubes via direct numerical simulations 247
*R. Takaki and A.K.M.F. Hussain*
Singular interaction of vortex filaments 251
*S. Kida and M. Takaoka*
Reconnection of vortex tubes 257

**5. Vortex breakdown**

*E. Krause*
Numerical prediction of vortex breakdown 263
*A. Schmücker and K. Gersten*
Vortex breakdown and its control on delta wings 268

**6. Stability and turbulence**

*T. Tatsumi*
Dynamics of large-scale eddies in turbulent flows 273
*M. Farge*
Vortex motion in a rotating barotropic fluid layer 282
*E. Kit, A. Tsinober, M. Teitel, J.L. Balint, J.M. Wallace and E. Levich*
Vorticity measurements in turbulent grid flows 289
*U. Frisch, H. Scholl, Z.S. She and P.L. Sulem*
A new large-scale instability in three-dimensionl incompressible flows lacking parity-invariance 295
*M. Mory*
Coherent vortices in a turbulent and rotating fluid 299
*M. Ohji and K. Amagai*
Structure of modulated wavy vortical flows in the circular Couette system 305
*J.P. Chollet, M. Lesieur and P. Comte*
Numerical simulations of vortices in mixing layers and plane jets 315
*R.A. Pasmanter*
Anomalous diffusion and anomalous stretching in vortical flows 320
*T. Nakano*
Vorticity field in a cascade model of turbulence 327
*C.H. Gibson*
Isoenstrophy points and surfaces in turbulent flow and mixing 331

**7. Vortex and sound**

*K. Shariff, A. Leonard, N.J. Zabusky and J.H. Ferziger*
Acoustics and dynamics of coaxial interacting vortex rings 337

*G.E.A. Meier, H.-M. Lent and K.F. Löhr*
Sound generation and flow interaction of vortices with an airfoil and a flat plate in transonic flow 344
*M.C. Thompson, K. Hourigan, M.C. Welsh and W.K. Soh*
Prediction of vortex shedding from bluff bodies in the presence of a sound field 349
*M. Mathias, A.N. Stokes, K. Hourigan and M.C. Welsh*
Low-level flow-induced acoustic resonances in ducts 353
*T. Minota, T. Kambe and T. Murakami*
Acoustic emission from interaction of a vortex ring with a sphere 357
*O. Mochizuki, M. Kiya and M. Tazumi*
Vortex – body interaction in a jet – circular cylinder sound generating system 363
*M. Kawahashi, E. Brocher and P. Collini*
Coupling of vortex shedding with a cavity 369

**8. High speed flow**

*D.W. Moore and D.I. Pullin*
The vortex pair in a compressible ideal gas 377
*H. Hornung and A. Elsenaar*
Detailed measurements in the transonic vortical flow over a delta wing 381
*A. Nastase*
Some considerations on leading edge vortices on wings in supersonic flow 387
*J.W. Chalmers, S.W. Hodson, K.-H.A. Winkler, P.R. Woodward and N.J. Zabusky*
Schock-bubble interactions: generation and evolution of vorticity in two-dimensional supersonic flows 392

**9. Stratified and rotating fluids**

*R. Kimura*
Cell formation in the convective mixed layer 395
*M. Takematsu and T. Kita*
The behavior of isolated free eddies in a rotating fluid: Laboratory experiment 400
*H. Niino*
Inertial instability of the Stewartson $E^{1/4}$-layer 407
*K. Noto, M. Honda and R. Matsumoto*
Coherent motion of turbulent thermal plume in stably stratified fluid 415
*L.M. Polváni, N.J. Zabusky and G.R. Flierl*
Applications of contour dynamics to two layer quasigeostrophic flows 422
*H. Honji*
Vortex motions in stratified wake flows 425

List of participants 431
Photos 434
Author index 437